

09/920,981 filed 08/02/2001 Art Unit 1764
Response to Notice of Non-Compliant Amendment dated 12/12/2005

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the Application:

Listing of the Claims

5 Pending Claims

1. (previously presented): A flow reactor comprising a plurality of walled conduits each having an outer surface disposed for contact with a heat-transfer medium, an inlet distribution manifold adapted for flow communication with a downstream manifold through
10 channels formed by heterogeneous catalytic material disposed within each conduit during operation in a sequence of zones for catalyst having the same or different length along the longitudinal coordinate of the conduit and within each zone essentially uniform cross-section of the conduit measured in a plane perpendicular to the longitudinal
15 coordinate thereby defining volume of the zone, and the sequence of zones comprising at least three zones such that each downstream zone has a different cross-section than the contiguous upstream zone, and wherein the cross-section of the conduit in each zone has a substantially circular form with a diameter such that the third power
20 of the diameter is equal to the product of the volume and a geometric factor having values in a range from about 0.01 to about 0.50.

2. (original): The flow reactor according to Claim 1, further comprising a shell adapted to maintain during operation the outer surface of each conduit predominantly in contact with a heat-transfer
25 medium, and having an inlet in flow communication with an outlet for the heat-transfer medium.

3. (original): The flow reactor of Claim 1, wherein cross-section and length of each zone are sized so that the heat generated during any exothermic reactions occurring inside the conduits of the

09/920,981 filed 08/02/2001

Art Unit 1764

Response to Notice of Non-Compliant Amendment dated 12/12/2005

zone does not exceed the amount of heat capable of being transferred to and removed by the heat transfer medium surrounding the conduits.

4. (previously presented): The flow reactor according to
5 Claim 1, wherein the sequence of zones comprises at least four zones.

5. (previously presented): The flow reactor according to
Claim 1, wherein each downstream zone has a larger cross-section
than the contiguous upstream zone.

6. (original): The flow reactor according to Claim 1, wherein
10 each downstream zone has a larger volume than the contiguous
upstream zone.

7. (canceled)

8. (previously presented): The flow reactor according to
claim 1, wherein the geometric factor of each downstream zone is
15 larger than the contiguous upstream zone for the sequence of zones
comprises at least three zones.

9. (original): The flow reactor according to Claim 1, wherein
the zones for catalyst have a total length along the longitudinal
coordinate of at least 4 meters.

20 10. (previously presented): The flow reactor according to
Claim 1, wherein the geometric factor has values in a range from about
0.015 to about 0.100.

11. (original): The flow reactor according to Claim 10, wherein
the geometric factor of each downstream zone is larger than the
25 contiguous upstream zone for the sequence of zones comprises at least
three zones.

09/920,981 filed 08/02/2001

Art Unit 1764

Response to Notice of Non-Compliant Amendment dated 12/12/2005

12. (withdrawn): A flow reactor comprising:

- 5 (i) a plurality of walled conduits each having an outer surface disposed for contact with a heat-transfer medium,
- (ii) an inlet distribution manifold adapted for flow communication with a downstream manifold through channels formed by heterogeneous catalytic material disposed within each conduit during operation,
- (iii) a sequence of zones comprising at least two zones, said zones comprising said walled conduits, wherein
- 10 (a) the walled conduits within each zone have the same or different length measured along the longitudinal coordinate of the zone,
- (b) the walled conduits within each zone have essentially uniform cross-section measured in a plane perpendicular to the longitudinal coordinate thereby defining volume of the zone, and
- 15 (c) in the sequence of zones, the total cross-section area of the conduits in each downstream varies from the prior up stream zone,
- 20 (iv) at least one crossover chamber in flow communication with the plurality of walled conduits of a downstream zone and the plurality of walled conduits of the prior upstream zone,
- (v) a shell adapted to maintain during operation the outer surface the plurality of walled conduits of each zone predominantly in contact with a heat-transfer medium, and
- 25 (vi) the shell having an inlet in flow communication with an outlet for flow of the heat-transfer medium.

13. (withdrawn): The flow reactor according to Claim 12, wherein cross-section and length of each zone are sized so that the

30 heat generated during any exothermic reactions occurring inside the

09/920,981 filed 08/02/2001

Art Unit 1764

Response to Notice of Non-Compliant Amendment dated 12/12/2005

conduits of the zone does not exceed the amount of heat capable of being transferred to and removed by the heat transfer medium surrounding the conduits.

14. (withdrawn): The flow reactor according to Claim 12,
5 wherein the sequence of zones comprises at least three zones.

15. (withdrawn): The flow reactor according to Claim 12,
wherein each downstream zone has a larger cross-section than the
contiguous upstream zone.

16. (withdrawn): The flow reactor according to Claim 12,
10 wherein each downstream zone has a larger volume than the
contiguous upstream zone.

17. (withdrawn): The flow reactor according to Claim 12,
wherein at least one crossover chamber has an inlet in flow
communication with the plurality of walled conduits of a downstream
15 zone.

18. (withdrawn): The flow reactor according to claim 12
further comprising a shell adapted to maintain during operation the
outer surface of each conduit predominantly in contact with a heat-
transfer medium, and having an inlet in flow communication with an
20 outlet for the heat-transfer medium.

19. (withdrawn): The flow reactor according to claim 18
wherein the cross-section of the conduit in each zone has a
substantially circular form with a diameter such that the third power
of the diameter is equal to the product of the volume and a geometric
25 factor having values in a ranger from about 0.01 to about 0.50.

20. (withdrawn): The flow reactor according to claim 18
wherein the geometric factor of each downstream zone is larger than
the contiguous upstream zone for the sequence of zones comprises at
least three zones

09/920,981 filed 08/02/2001

Art Unit 1764

Response to Notice of Non-Compliant Amendment dated 12/12/2005

21. (withdrawn): The flow reactor according to claim 12 wherein the zones for catalyst have a total length along the longitudinal coordinate of at least 4 meters.

5 22. (withdrawn): The flow reactor according to claim 12 wherein the cross-section of the conduit in each zone has a substantially circular form with a diameter such that the third power of the diameter is equal to the product of the volume and a geometric factor having values in a range from about 0.015 to about 0.100.

10 23. (withdrawn): The flow reactor according to claim 22 wherein the wherein the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprising at least three zones.

15 24. (withdrawn): A process which includes exothermic chemical conversions of organic compounds to value added products using a selective heterogeneous catalyst in at least one flow reactor comprising a plurality of walled conduits each having an outer surface disposed for contact with a heat-transfer medium, an inlet distribution manifold adapted for flow communication with an downstream manifold through channels formed by heterogeneous catalytic material
20 disposed within each conduit during operation in a sequence of zones having the same or different length along the longitudinal coordinate of the conduit and within each zone essentially uniform cross-section of the conduit measured in a plane perpendicular to the longitudinal coordinate thereby defining volume of the zone, and the sequence of
25 zones comprising at least two zones such that each downstream zone has a larger cross-section and volume than the contiguous upstream zone.

30 25. (withdrawn): The process according to claim 24 wherein the sequence of zones in the flow reactor comprises at least three zones.

09/920,981 filed 08/02/2001

Art Unit 1764

Response to Notice of Non-Compliant Amendment dated 12/12/2005

26. (withdrawn): The process according to claim 24 wherein the cross section and length of each zone in the flow reactor are sized so that the heat generated during any exothermic reactions occurring inside the conduits of the zone does not exceed the amount
5 of heat capable of being transferred to and removed by the heat transfer medium surrounding the conduits.

27. (withdrawn): The process according to claim 24 the each downstream zone in the flow reactor has larger cross-section than the contiguous upstream zone.

10 28. (withdrawn): The process according to claim 24 wherein each downstream zone in the flow reactor has a larger volume than the contiguous upstream zone.

15 29. (withdrawn): The process according to claim 24 wherein the exothermic chemical conversions of organic compounds to value added products comprises oxidation of benzene or a hydrocarbon selected from the group consisting of n-butane, butene-1 and butadiene, to form maleic anhydride.

20 30. (withdrawn): The process according to claim 24 wherein the exothermic chemical conversions of organic compounds to value added products comprises oxidation of n-butane to form maleic anhydride by contacting n-butane at low concentration in an oxygen-containing gas with a fixed catalyst comprising principally tungsten, phosphorus and oxygen.

25 31. (withdrawn): The process according to claim 24 wherein the catalyst is maintained at a temperatures in a range from about 360°C to about 530°C.

30 32. (withdrawn): The process according to claim 24 wherein the cross-section of each downstream zone which has a larger cross-section than the cross-section of the contiguous upstream zone is larger by an amount such that during operation temperatures of the

09/920,981 filed 08/02/2001

Art Unit 1764

Response to Notice of Non-Compliant Amendment dated 12/12/2005

exotherm as measured along the centerline are no more than 50°C higher than the heat-transfer medium temperature.

33. (previously presented): The flow reactor according to Claim 1, wherein each downstream zone has a larger cross-section than the contiguous upstream zone, and wherein the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprising at least three zones.

34. (previously presented): The flow reactor according to Claim 1, wherein each downstream zone has a larger cross-section than the contiguous upstream zone, and wherein the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprising at least four zones.

35. (new): A flow reactor comprising a plurality of walled conduits each having an outer surface disposed for contact with a heat-transfer medium, an inlet distribution manifold adapted for flow communication with a downstream manifold through channels formed by heterogeneous catalytic material disposed within each conduit during operation in a sequence of zones for catalyst having the same or different length along the longitudinal coordinate of the conduit and within each catalyst-containing zone essentially uniform cross-section of the conduit measured in a plane perpendicular to the longitudinal coordinate thereby defining volume of each catalyst-containing zone, and the sequence of catalyst-containing zones comprising at least four catalyst-containing zones such that each downstream catalyst-containing zone has a larger total cross-section than the contiguous upstream catalyst-containing zone, and wherein at least three of the downstream catalyst-containing zones has a larger total volume than the contiguous upstream catalyst-containing zone.

36. (new): The flow reactor according to Claim 35, wherein the cross-section of the conduits in each catalyst-containing zone have a substantially circular form with diameter such that the third power

09/920,981 filed 08/02/2001

Art Unit 1764

Response to Notice of Non-Compliant Amendment dated 12/12/2005

of the diameter is equal to the product of the volume of each conduit in the zone and a geometric factor having values in a range from about 0.01 to about 0.50.

37. (new): The flow reactor according to Claim 36, wherein
5 the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprises at least three zones.

38. (new): The flow reactor according to Claim 35, wherein
10 the cross-section of the conduits in each catalyst-containing zone have a substantially circular form with diameter such that the third power of the diameter is equal to the product of the volume of each conduit in the zone and a geometric factor having values in a range from about 0.015 to about 0.100.

39. (new): The flow reactor according to Claim 38, wherein
15 the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprises at least three zones.

40. (new): The flow reactor according to Claim 38, further
20 comprises a shell adapted to maintain during operation the outer surface of each conduit predominantly in contact with a heat-transfer medium, and having an inlet in flow communication with an outlet for the heat-transfer medium.

41. (new): The flow reactor according to Claim 40, wherein
25 cross-section and length of each zone are sized so that the heat generated during any exothermic reactions occurring inside the conduits of the zone does not exceed the amount of heat capable of being transferred to and removed by the heat transfer medium surrounding the conduits.